

ACCESSION #: 9810070100

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Sequoyah Nuclear Plant (SQN) Unit 2 PAGE: 1 OF 9

DOCKET NUMBER: 05000328

TITLE: Turbine and Reactor Trips Resulting From a Failure of the
'B' Phase Main Transformer Sudden Pressure Relay.

EVENT DATE: 08/27/1998 LER #: 1998-001-00 REPORT DATE: 09/28/1998

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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Engineer

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: FK COMPONENT: RLY MANUFACTURER: Q011

REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 27, 1998, at 1357 Eastern Day light time, with Unit 2 in power operation at approximately 100 percent, a turbine trip occurred followed by a reactor trip. The event resulted from the initiation of a generator lockout (generator electrical trip) with a subsequent turbine trip initiated by failure of a sudden pressure relay on the 'B' phase main transformer. A review of the condition determined that the transformer did not

experience a fault. The reactor protection systems, including feedwater isolation and auxiliary feedwater start, responded to the trip as expected; no anomalies occurred. Operators responded to the trip as prescribed by procedures and stabilized the reactor in the hot standby condition. Subsequent to the event, examination of the sudden pressure relay, Qualitrol Corporation Model No. 900-003-01, identified one rocker arm pin had worn to the degree that proper operation of the device was prevented. The remaining Qualitrol relays on the Units 1 and 2 plant transformers inservice were inspected and replaced, where necessary.

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I. PLANT CONDITIONS

Unit 2 was in power operation at approximately 100 percent.

II. DESCRIPTION OF EVENT

A. Event

On August 27, 1998, at 1357 Eastern Daylight time (EDT), a turbine trip occurred followed by a reactor trip. The event resulted from initiation of a generator lockout (generator electrical trip) with a subsequent turbine trip initiated by failure of a sudden pressure relay [EIIS Code RLY] on the 'B' phase main transformer [EIIS Code FK]. A review of the condition determined that the transformer did not experience a fault. The reactor protection systems, including feedwater isolation and auxiliary feedwater start, responded as expected to the trip; no anomalies occurred. Operators responded to the trip as prescribed by procedures and stabilized the reactor in the hot standby condition.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

C. Dates and Approximate Times of Major Occurrences

TIMELINE

August 27, 1998, The generator lockout, with at 1357 subsequent turbine trip was followed by a reactor trip. The trip signal was initiated by the 'B' phase main transformer sudden pressure relay.

The main control room operators stabilized the reactor in Mode 3 (hot standby).

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D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

The turbine and reactor trips were annunciated on the main control room panels.

F. Operator Actions

Control room operators responded as prescribed by emergency procedures.

The condition was promptly diagnosed, and the necessary actions were taken to stabilize and maintain the unit in a safe condition.

G. Safety System Responses

The plant responded to the turbine and reactor trips as designed.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the event was initiation of a generator lockout (generator electrical trip) signal by the 'B' phase main transformer

protection circuit from a failed sudden pressure relay.

B. Root Cause

The root cause of the event was the failure of a sudden pressure relay located on the 'B' phase main transformer. Troubleshooting, following the unit trip, found that the sudden pressure relay had not reset as would be expected. Field examination of the device found the housing interior oily and covered with a dark residue. Disassembly of the relay determined that one rocker arm pin had worn to the degree that proper

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operation of the device was prevented (the device was in a constant trip condition). The pin failure mechanism appears to be wear (fretting) resulting from vibration. oil leakage into the relay housing resulted from either an inadequate factory assembly torque between the protective shield and the relay mechanism to prevent transformer oil leakage or leakage of the silicon fluid from the relay mechanism due to a failure of the bellows assembly.

C. Contributing Factors

None.

IV. ANALYSIS OF THE EVENT

The plant safety systems responses during and after the unit trip were consistent with the responses described in the Updated Final Safety Analysis Report, and accordingly, the event did not adversely affect the health and safety of plant personnel or the general public.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Control room operators responded as prescribed by emergency procedures.

The condition was promptly diagnosed, and the necessary actions were taken to stabilize and maintain the unit in a safe condition.

B. Corrective Actions to Prevent Recurrence

Subsequent to the event, several Qualitrol sudden pressure relays located on other transformers were removed and inspected. Of the 21 total Unit 1 and 2 installed devices, 20 relays have been inspected with 13 requiring replacement (3 due to oil leakage and 10 for fretting). The one remaining device that has not

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been inspected is located on a transformer that is not currently in service and has not been in service since initial installation. Discussions with the manufacturer determined that the acceptable "breakaway" torque, between the protective shield and the relay mechanism, is between 900 to 1,200 inch-pounds. To prevent oil leakage into the relay housing and ensure reduced mechanism vibration, "break-away" torque is being verified on each of the devices, both new and old. Of the 17 new devices that were examined, 9 met the vendor torque criteria. Where unacceptable torque values are found, the device is being retorqued to 1,200 inch-pounds before installation.

VI. ADDITIONAL INFORMATION

A. Failed Components

The sudden pressure relay, Qualitrol Corporation Model No. 900-003-01, was examined and found to have failed (the device was in a constant trip condition). Detailed inspection of the component identified significant wear on the rocker arm pins. One of the rocker arm pins had worn to the degree that proper operation of the device was prevented. In addition to this failure mechanism, the wear products (particles of metal [brass with a high percentage of copper content]) were accumulated and trapped in an oil film around the exposed electrical switch wiring as it attached to the connector. This condition could have lead to arcing and subsequent actuation of the auxiliary trip relays within the plant. The oil within the electrical switch enclosure is attributed to either a low torque on the protective shield, resulting in an incomplete seal on the o-ring that seals the relay mechanism or failure of the bellows assembly and leakage of the silicon fluid into the housing.

Analysis of the failed devices, examination of the "as constructed" configuration, and tests ongoing at the

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TVA Central Laboratories presently indicate that excessive vibration is being seen by the relay mechanism. This vibration appears to be the result of:

1. The transformer's 60 Hertz pulsation and the resultant vibrations at some harmonic of 60 Hertz.

2. The natural resonant frequency of the mounted assembly which includes the sudden pressure relay, pipe, flanges, and isolation valve.

3. The natural resonant frequency of the relay mechanism (control bellows, rocker arm pins, actuator linkages, etc.) that is within the device.

The largest amount of fretting was found on the transformers with the sudden pressure device mounted in a configuration consisting of a flange, threaded pipe, and gate valve. This mounting configuration was installed during the last transformer bank outages to correct an interference problem with an originally installed butterfly valve. Slight fretting has also been observed on two devices still mounted with the original butterfly valve. Further analysis and testing is ongoing to resolve these vibrational issues.

No fretting or vibrational issues have been observed on the plant common station service transformers which provide the offsite power feeds to the plant.

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Figure "QUALITROL 900 SERIES "RAPID PRESSURE RISE" RELAY" omitted.

PRINCIPLE OF OPERATION: Changes in the transformer's internal pressure deflects the Sensing Bellows and responding Control Bellows that are part of a sealed system filled with Silicon Fluid. A small Control Orifice in the line of one of the Control Bellows, whose effective area is varied with temperature by a Bimetal Temperature Compensator, causes differential

deflection of the two Control Bellows. The resultant "cocking" of the Actuator Linkage trips the Electrical Switch at unsafe rates of pressure rise. When the two Control Bellows again reach equilibrium, the Electrical Switch automatically resets itself.

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Figure omitted.

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B. Previous LERs on Similar Events

A review of previous events identified three other events (50-327/86026, 90022, and 95010) associated with the failure of the sudden pressure relay. Those failures resulted from a shorted micro-switch, shorted wiring terminal, or a failure of the nonorificed control bellows. Actions taken for those failures would not have prevented the event described by this LER. Following the 1995 event, Qualitrol sudden pressure relays at SQN were replaced.

C. Additional Information

None.

VII. COMMITMENTS

None.

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